What's in a Name?

And are we talking about a revolution?

Sustainable Remediation
or
Green Remediation

Stephanie Fiorenza, BP

SAM Forum
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San Diego

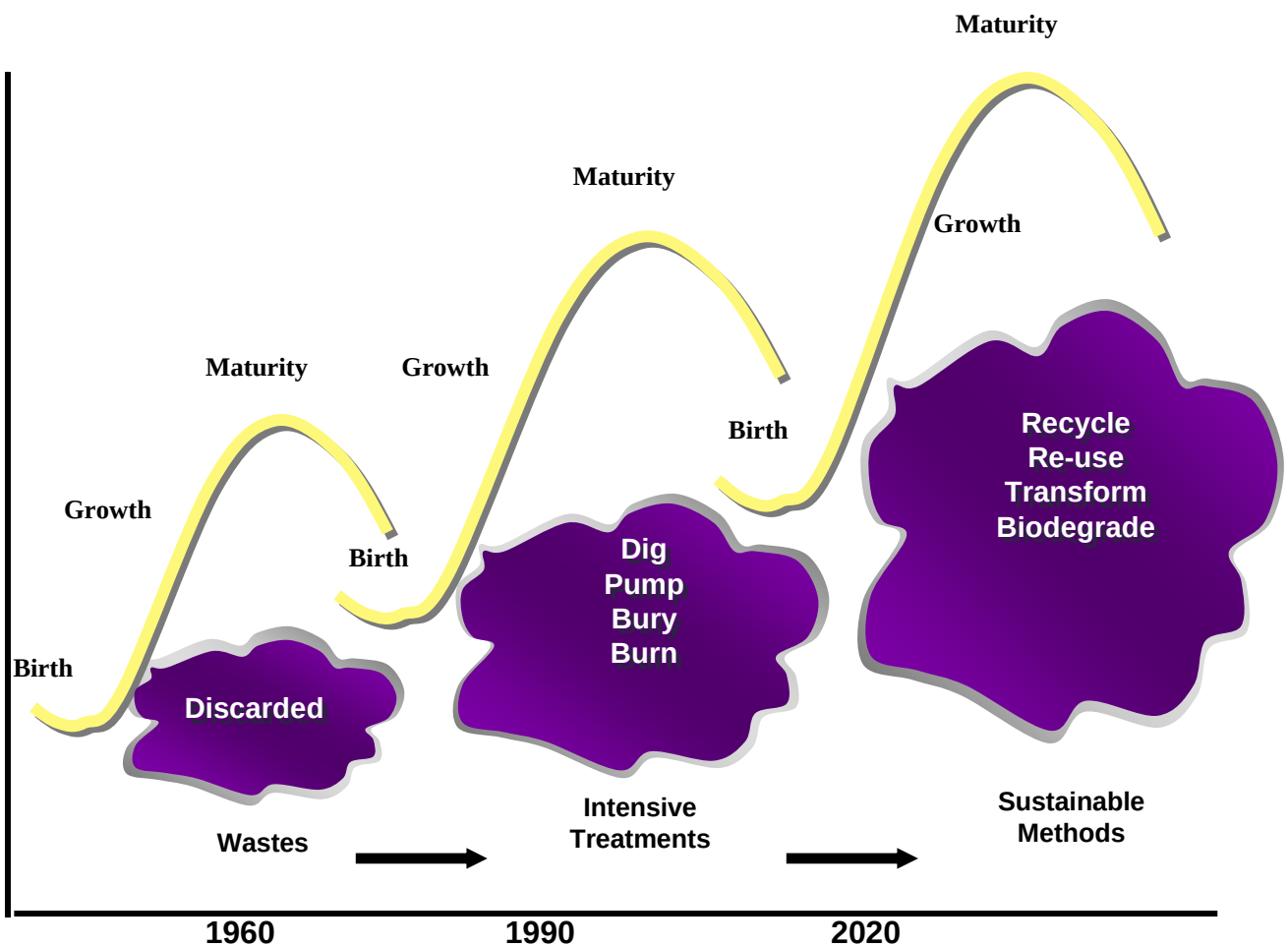
Outline

- **Definitions and issues**
- **Development of SURF**
- **Metrics**
- **Concurrent events in ‘sustainable’ remediation**
- **Possible future directions and efforts**

ON THE HORIZON

- **Carbon cap and trading**
- **Potential for required reporting of remediation system emissions and mandated elements (energy efficiency e.g.)**
- **“Green Cleanup Certification”**

Evolution of Thinking about Waste and Cleanups*



*SURF White Paper

Definitions and Issues

- **Green (remediation)**
- **Sustainable (remediation)**
  - **Aid decision-making**
- **Improved definition – applying sustainability concepts to remediation**
- **Metrics and efficiencies – what and where; parameters and boundaries (time and space)**
- **Who decides?**
- **Regulatory requirements?**

SUstainable Remediation Forum

- **Started November 2006**
- **Modeled on RTDF; quarterly meetings**
- **Individuals from variety of disciplines + employment**
  - **DuPont, BP, Shell, Chevron, EPA HQ, EPA Regions 3, 6, 9, DTSC, State of Delaware, CH2M Hill, EarthTech, ERM, GSI, GeoSyntec, DoD - Air Force, Army, Navy, DOE**
- **Consensus-based**
- **Collaborations – UK, US Federal and regional/local govt**

SUstainble Remediation Forum

- **Sweat-equity Work Products - White Paper; analyses of remediation technologies**
- **Education and outreach - presentations**
- **Issues – growing pains, metrics, identity, governance**
- **Steering committee – representative of membership**

ibackup site: surfarchive (username); surf (pw)

White Paper

- Introduction
- Current Status
  - Programs in N. America and Europe
- Concepts and Practices
  - Site Assessment
  - Metrics
  - Performance Monitoring
- A Vision
  - Regulatory Aspects
  - Market Forces
- Impediments and Barriers
  - Social
  - Technical
  - Economic
  - Regulatory/Legal
- Case Studies

Metrics

- **Quantitative**
  - **Carbon calculators ---- PLUS ----**
- **Qualitative**
  - **Checklists/thumbs up-down**
- **Hybrid**
  - **Scored checklists**

- **Tiered**
- **Life Cycle Approach**

Carbon Footprint Assessment (Activity Totals By Task)

Activity totals	Units	Total Resources Required for Activity	Units	Total CO_2 Emissions (Pounds)
Task Total - task 1 - Groundwater Monitoring				
1527.4	light miles	72.63	gallons of gasoline	1,421
1903.5	kW hours	1,903.50	kW hours	2,039
	Pounds of CO_2 Task 1			**3,460**
Task Total - task 2 - Remediation				
180.0	light miles	8.56	gallons of gasoline	167
120	heavy miles	12.00	gallons of diesel	269
24	light equipment hours	13.20	gallons of gasoline	258
	Pounds of CO_2 Task 2			**694**
Task Total - task 3 - Reporting				
720	kW hours	720.00	kW hours	771
36	Ccf natural gas consumption	36.00	Ccf	434
	Pounds of CO_2 Task 3			**1,205**
Task Total - task 4 - Additional Activities				
0.0	light miles	0.00	gallons of gasoline	0
0	heavy miles	0.00	gallons of diesel	0
0	heavy machine hours	0.00	gallons of diesel	0
	Pounds of CO_2 Task 4			**0**

Carbon Footprint Assessment Summary

Impacted Area (Acres)	Hydrocarbon Present (lbs)	Equivalent vol. of gasoline (gal)	Total CO_2 Emissions to Close Site (Pounds)	Total CO_2 Emissions to Close Site (Tons)	Efficiency (lbs hydrocarbon present/lbs CO_2 emitted)
0.36	0.05	0.06	6,581	3.3	0.00001
1.24	0.18	0.62	6,820	3.4	0.00003
0.34	0.23	0.96	6,133	3.1	0.00004
0.23	0.30	0.31	3,668	1.8	0.00008
0.57	0.70	0.64	5,324	2.7	0.00013
0.78	0.77	0.68	2,157	1.1	0.00036
2.54	2.33	3.65	3,688	1.8	0.00063
2.66	1.09	1.37	1,587	0.8	0.00069
1.61	7.36	8.88	5,359	2.7	0.00137
5.39	8.80	7.59	5,147	2.6	0.00171
3.23	261.79	326.79	10,410	5.2	0.02515

DuPont/URS Spreadsheet Tool

	Parameters	ZVI-Clay In-Situ Treatment	Excavation & Off-Site Disposal	Ex-Situ Thermal Desorption	Soil Vapor Extraction	Capping
Tons of CO_2 Equivalents		85	252	586	306	21
Energy Usage (kWh)		308,103	911,883	2,348,094	700,999	113,287
Occupational Risk	Exposure Hours	3,562	4,364	5,482	3,952	612
	Mileage	10,942	109,815	15,662	16,742	4,645
Resource Usage	Potable Water (gal)	0	0	0	0	0
	Groundwater (gal)	130,000	0	0	0	0
	Soil (ton)	200	3,400	400	170	1,200
	Landfill Space (acre-ft))	0	2	0	0	0
	Land (Acre)	0.3	0.3	0.3	0.3	0.3
	Air	0	0	0	0	0
Local	Dust Generation	Moderate	High	Moderate	Moderate	Moderate
	Noise Level	Moderate	High	High	Moderate	Moderate
	Traffic Congestion	Moderate	High	Low	Moderate	Moderate
Consumables	Gasoline (gal)	512	249	820	1,342	118
	Diesel (gal)	6,155	19,346	7,084	1,719	987
	PVC (lf)	0	0	0	1,850	0
	Steel Wells (lf)	0	0	0	15	0
	HDPE (sf)	0	0	0	0	7,800
	Carbon (ton)	0	0	0	0	0
	Cement (ton)	0	0	0	0	0
	Concrete (ton)	0	0	0	5	0
	ZVI (ton)	70	0	0	0	0
	Bentonite (ton)	50	0	0	0	0
	Kiln Dust (ton)	200	0	0	0	0
	Asphalt (ton)	200	0	0	170	0
	Grid Energy (kWh)	0	0	17,332	542,388	0
	Propane (lbs)	0	0	319,762	0	0

Screening Environmental Parameters

IMPACTS or DEBITS

Parameter / Technology	CO_2 emissions	VOC emissions	Land Usage/Time	Water Usage
S/S with pumping	Y	Y	Y	Y
S/S without pumping	Y	Y	Y	N
Incineration On site	YY	N	N	N
Incineration Off site	YY	N	N	N

Additional Sustainability Parameters

	Occupational Exposure	Mileage	Activity Risk	Community – noise, dust, traffic
S/S in situ, with pumping	Y	N	Y	N
S/S on site, without pumping	Y	N	Y	N
On site Incineration	Y	N	Y	Y
Off site Incineration	Y	Y	Y	Y

INPUT DATA

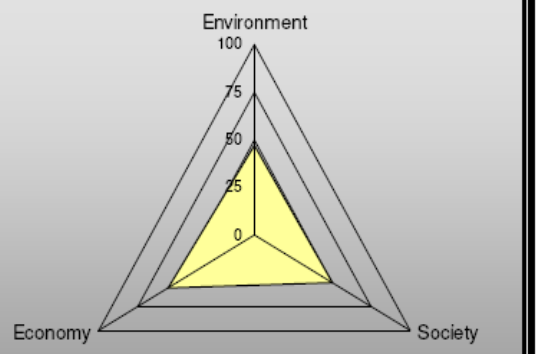
Indicator ID	ENVIRONMENTAL ASPECT	Option 1	Option 2	Option 3	Option 4	Option 5	Weight
	Soil Quality						
ENV-1	Soil Quality Improvement	0	0	33	0	66	1
	Sediment Quality						
ENV-2	Sediment Quality Improvement	NA	NA	NA	NA	NA	NA
	Water						
ENV-3	Groundwater Quality Improvement	0	33	66	33	66	2
ENV-4	Free Product Removal	33	33	100	33	66	3
ENV-5	Surface Water Quality Improvement	0	0	50	50	50	1
ENV-6	Responsible Water Consumption	100	100	50	100	0	1
	Ecosystem and Drinking Water Supply						
ENV-7	Wildlife and Flora Conservation	NA	NA	NA	NA	NA	NA
ENV-8	Drinking Water Supply Conservation	NA	NA	NA	NA	NA	NA
ENV-9	Off-site Migration Prevention	0	50	100	50	50	3
	Atmosphere						
ENV-10	Greenhouse Gas Emissions	100	50	0	50	100	1
	Consumed Energy						
ENV-11	Energy Conservation	100	100	50	100	150	3
	Residual Matter						
ENV-12	Solid Residual Matter Management	100	0	50	50	50	1
ENV-13	Site Contaminant Management	100	100	100	100	100	1
ENV-14	Hazardous Waste Management	NA	NA	NA	NA	NA	NA
	Additional Indicators						
ENV-15							
ENV-16							
	SOCIAL ASPECT	Option 1	Option 2	Option 3	Option 4	Option 5	Weight
	Health and Safety						
SOC-1	Local Resident Safety and Quality of Life	100	100	100	100	100	1
SOC-2	Worker Safety	150	150	150	150	150	3
	Impact on Community						
SOC-3	Limited Duration of Work	0	0	66	0	0	1
SOC-4	Benefits for CN and Subcontractor Staff	0	0	50	0	50	1
SOC-5	Beneficial Use for the Local Community	0	0	0	0	0	1
	Equity						
SOC-6	Employee Skill Development	0	50	100	50	50	1
SOC-7	Local Job Creation and Diversity	0	50	50	50	50	1
	Corporate Image						
SOC-8	Competitive Advantage through Innovation	50	50	100	50	100	1
SOC-9	Response to Social Sensitivity	0	50	100	50	100	2
	Standards, Laws and Regulations						
SOC-10	Standards, Laws and Regulations	50	50	100	50	100	3
	Additional Indicators						
SOC-11							
SOC-12							
	ECONOMIC ASPECT	Option 1	Option 2	Option 3	Option 4	Option 5	Weight
	Economic Performance						
ECON-1	Initial Capital Cost Moderation	60	60	45	90	90	3
ECON-2	Low Annual Operation, Maintenance, Monitoring Costs	80	60	60	80	80	3
ECON-3	Prevention of Potential Litigation	0	0	50	0	50	3
ECON-4	Potential Grants or Subsidies	0	0	0	0	25	1
	Environmental Liabilities						
ECON-5	Environmental Liabilities Reduction	33	66	100	66	66	3
	Competitivity						
ECON-6	Train Service Reliability and Performance	100	100	100	100	100	3
	Community Economic Growth						
ECON-7	Donations to the Community	NA	NA	NA	NA	NA	NA
ECON-8	Economic Advantages for the Local Community	0	50	50	50	50	1
	Reliability						
ECON-9	Reliability (Moderate Maintenance and Repair)	100	50	0	50	50	2
	Technological Aspect						
ECON-10	Economic Advantage of More Effective Technology	0	0	0	0	50	1
ECON-11	Technological Uncertainty Management	100	100	100	100	50	2

Canadian National - Golder Tool Output

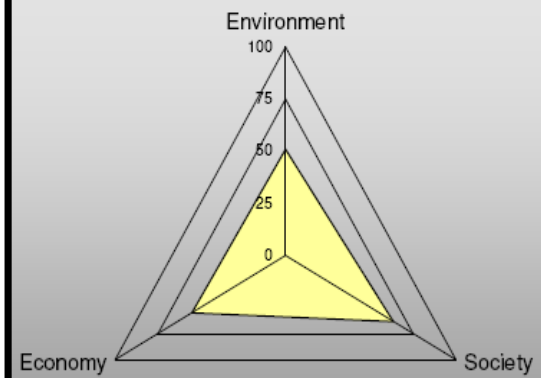
SUSTAINABLE PERFORMANCE OF OPTIONS

A score higher than 50% indicates a net positive impact, below 50% a net negative impact. The largest triangle represents the most sustainable option, particularly if the triangle is equilateral.

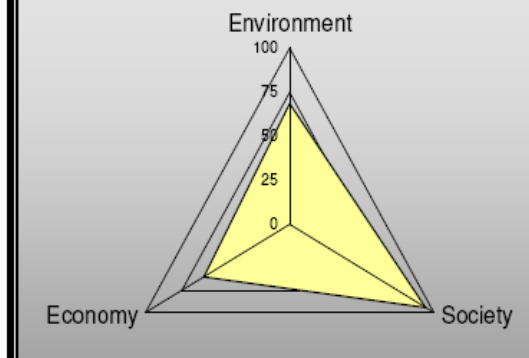
RESULTS - OPTION 1	
ENVIRONMENT	47%
SOCIETY	50%
ECONOMY	55%



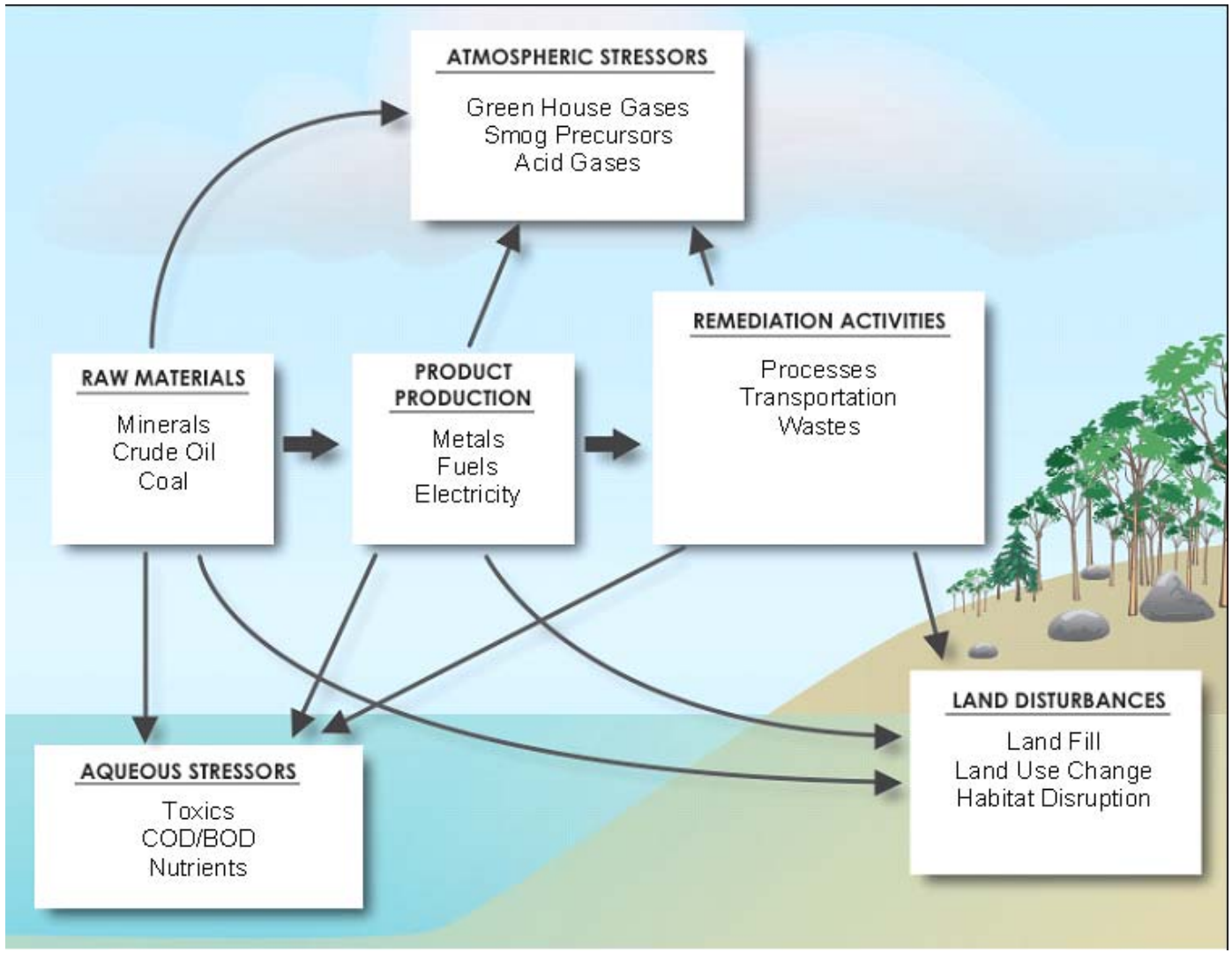
RESULTS - OPTION 2	
ENVIRONMENT	51%
SOCIETY	63%
ECONOMY	55%



RESULTS - OPTION 3	
ENVIRONMENT	69%
SOCIETY	94%
ECONOMY	60%

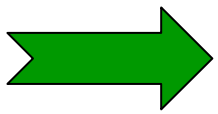


Life Cycle Approach



Variable Metrics, Impacts

Different sites have different key sustainability parameters



Metrics vary by site

Remedial Approach has different effects on different sustainability parameter

Simplify, Simplify

SITE KNOWLEDGE

QUALITATIVE SCREENING

SHORT LIST OF TECHNOLOGIES

SCOPE OUT TASKS

DETAILED SUSTAINABILITY ASSESSMENT OF UNIQUE TASKS

RELATIVE ANALYSIS

CONTAMINANT REMOVAL/CO_2 GENERATED

Concurrent Activities

- EPA (HQ) – Green Remediation document
  - http://clu-in.org/greenremediation/
- Cal EPA (DTSC) – Green Remediation Team
  - http://www.dtsc.ca.gov/OMF/Grn_Remediation.cfm
- AFCEE Sustainable Remediation Tool Development
  - http://www.itrcweb.org/guidancedocument.asp?TID=42
- ITRC (Remediation Risk Management Green, Sustainable Remediation)
- EPA (Region 3 + HQ) – Certification proposal

- DuPont/URS
- Shell UK CBA
- Nicole
- Consultant one-offs

Future Directions/New Work

- **SERDP/ESTCP Statement of Need**
- **Retrospective studies/ comparison with predictive studies**
- **Sensitivity analyses, scale issues**
- **Develop rules of thumb**

Questions to Consider

- What metrics are appropriate for your site? For any site?
- What are the boundaries – spatial and temporal - of a remediation?
- Should sustainability be a balancing criterion?
- How will you identify and engage stakeholders?


bp

Carbon Dioxide Equivalents

	S/S in situ + GW	S/S on site	Incineration on site	Incineration off site
Preconstruction activities	141	141	141	141
Soil Management	8020	18,094 S+S	7169 S+S	8791 S+S
Sludge Management	1800	------	------	-----
Incineration	------	-----	84,648	91,080
O&M activities	59			
Total (tons CO_2)	9,953	18,235	98,932	107,090
Contaminant Removal (lbs)				
Ton Contaminant/Ton CO_2	10.4	32.4	5.9	5.5

A Sustainable Approach to Sustainability?

- **Keep Goal in mind – better remedial solution**
- **Screen key sustainability parameters – will vary by site and remediation technology**

  use for decision-making in remedy selection,

  holistic design of remedies

  → **qualitative analysis**
- **Tailor Detailed Assessment to end needs**

  → **quantitative analysis for carbon trading, e.g.**
- **A Detailed Assessment Implies Verification**
- **Must Consider contaminant destroyed/ CO_2 generated if looking at CO_2 equivalents**